IGCSE Biology 0610 (2026-2028) Revision Notes

Topic 17: Inheritance

This topic covers the fundamental principles of genetics, including the structure of DNA, the process of protein synthesis, cell division, and the mechanism of inheritance.

17.1 Chromosomes, Genes, and DNA

Term	Definition	Key Facts
Inheritance	The transmission of genetic information from generation to generation.	This is the basis of all genetic study.
Chromosome	A thread-like structure of DNA, found in the nucleus, that carries genetic information in the form of genes [1].	Humans have 46 chromosomes (23 pairs) in most body cells.
Gene	A short length of DNA found on a chromosome that codes for a specific protein [1].	Genes control characteristics by coding for structural proteins, enzymes, or hormones.
Allele	A version or form of a gene [1].	An individual inherits two alleles for each gene (one from each parent).
Diploid Nuclei	Nuclei with two sets of chromosomes ($2n$).	Found in most body cells (somatic cells). In humans, $2n=46$.
Haploid Nuclei	Nuclei with one set of unpaired chromosomes (n).	Found in gametes (sex cells: sperm and egg). In humans, $n=23$.

17.2 Cell Division (Mitosis and Meiosis)

Mitosis (Extended)

Mitosis is a type of nuclear division that gives rise to **two genetically identical cells** (clones) [2].

Feature	Description	Importance
Result	Two diploid ($2n$) daughter cells.	Used for **growth**, **repair** of damaged tissues, **replacement** of cells, and **asexual reproduction**.
Process	Chromosomes double, line up at the centre, and are pulled apart, ensuring each daughter cell receives an identical set of chromosomes.	Essential for maintaining the same genetic information in all somatic cells.

Meiosis (Extended)

Meiosis is a type of nuclear division that gives rise to **four genetically different cells** (gametes) [3].

Feature	Description	Importance
Result	Four haploid (n) daughter cells.	Used for the **production of gametes** (sperm and egg).
Process	Involves two divisions, reducing the chromosome number by half (reduction division) and introducing genetic variation through recombination.	Ensures that the zygote formed at fertilisation has the correct diploid number of chromosomes.

17.3 Protein Synthesis (Extended)

The sequence of bases in a gene determines the sequence of amino acids that make a specific protein [4].

1. **Transcription:** The DNA code (which is too large to leave the nucleus) is copied onto a smaller molecule called **messenger RNA (mRNA)**.

2. **Translation:** The mRNA moves out of the nucleus and attaches to a **ribosome**. The ribosome 'reads' the code in groups of three bases (a triplet code), with each triplet coding for a specific **amino acid**.
3. **Protein Formation:** The ribosome links the amino acids together in the correct sequence to form the specific protein.

Gene Expression (Extended): Although all body cells contain the same genes, most genes are 'switched off' (not expressed) in a particular cell. Only the genes that code for proteins vital to that cell's function are expressed [5]. This ensures cells only produce the specific proteins they need (e.g., a nerve cell does not produce the same amount of insulin as a pancreas cell).

17.4 Monohybrid Inheritance

This is the inheritance of characteristics controlled by a **single gene** [6].

Term	Definition	Example
Phenotype	The observable characteristics of an organism (what it looks like).	Tall, Short, Brown Eyes.
Genotype	The combination of alleles that control a characteristic.	**TT**, **Tt**, **tt**.
Dominant Allele	An allele that is always expressed in the phenotype, even if only one copy is present (e.g., **T**).	**TT** (homozygous dominant) and **Tt** (heterozygous) both show the dominant phenotype.
Recessive Allele	An allele that is only expressed in the phenotype if two copies are present (e.g., **t**).	**tt** (homozygous recessive) shows the recessive phenotype.
Homozygous	Having two identical alleles for a gene (e.g., **TT** or **tt**).	Also known as 'pure breeding'.
Heterozygous	Having two different alleles for a gene (e.g., **Tt**).	Also known as a 'hybrid'.

Punnett Squares: A diagram used to show the possible combinations of alleles that could be produced in the offspring and to determine the ratio of genotypes and phenotypes.

17.5 Codominance and Sex-Linked Characteristics (Extended)

Codominance

Codominance occurs when **both alleles in a heterozygous organism are expressed** in the phenotype [7].

- **Example: ABO Blood Group System.**
  - Alleles I^{A} and I^{B} are codominant.
  - Allele I^{O} is recessive to both I^{A} and I^{B}.
  - A person with genotype $\text{I}^{\text{A}}\text{I}^{\text{B}}$ will have blood group **AB** (both A and B antigens are expressed).

Genotype	Phenotype (Blood Group)
$\text{I}^{\text{A}}\text{I}^{\text{A}}$ or $\text{I}^{\text{A}}\text{I}^{\text{O}}$	A
$\text{I}^{\text{B}}\text{I}^{\text{B}}$ or $\text{I}^{\text{B}}\text{I}^{\text{O}}$	B
$\text{I}^{\text{A}}\text{I}^{\text{B}}$	AB (Codominant)
$\text{I}^{\text{O}}\text{I}^{\text{O}}$	O

Sex-Linked Characteristics

These are characteristics controlled by genes located on the **sex chromosomes** (usually the X chromosome) [8].

- **Sex Determination:** Females have XX chromosomes; males have XY chromosomes.
- **Mechanism:** The Y chromosome is much smaller and carries very few genes. Therefore, males only have one copy of the genes found on the X chromosome.
- **Result:** Males are more likely to express recessive characteristics (like red-green colour blindness or haemophilia) controlled by genes on the X chromosome because they do not have a second X chromosome to mask the recessive allele.
- **Carrier:** A female who is heterozygous for a sex-linked recessive condition (e.g., $\text{X}^{\text{H}}\text{X}^{\text{h}}$ for haemophilia) is a **carrier**. She does not have the condition but can pass the recessive allele to her offspring.

References

[1] Save My Exams. *Chromosomes, Genes & Proteins*. https://www.savemyexams.com/igcse/biology/cie/23/revision-notes/17-inheritance/17-1-inheritance-genes-and-cell-division/17-1-1-chromosomes-genes-and-proteins/ [2] Save My Exams. *Mitosis*. https://www.savemyexams.com/igcse/biology/cie/23/revision-notes/17-inheritance/17-1-inheritance-genes-and-cell-division/17-1-6-mitosis/ [3] Save My Exams. *Meiosis*. https://www.savemyexams.com/igcse/biology/cie/23/revision-notes/17-inheritance/17-1-inheritance-genes-and-cell-division/17-1-7-meiosis/ [4] Save My Exams. *Protein Synthesis*. https://www.savemyexams.com/igcse/biology/cie/23/revision-notes/17-inheritance/17-1-inheritance-genes-and-cell-division/17-1-4-protein-synthesis/ [5] Save My Exams. *Which Proteins are Synthesised?*. https://www.savemyexams.com/igcse/biology/cie/23/revision-notes/17-inheritance/17-1-inheritance-genes-and-cell-division/17-1-5-which-proteins-are-synthesised/ [6] Save My Exams. *Monohybrid Inheritance*. https://www.savemyexams.com/igcse/biology/cie/23/revision-notes/17-inheritance/17-1-inheritance-genes-and-cell-division/17-1-8-monohybrid-inheritance/ [7] Save My Exams. *Codominance & Sex-Linked Characteristics*. https://www.savemyexams.com/igcse/biology/cie/23/revision-notes/17-inheritance/17-1-inheritance-genes-and-cell-division/17-1-9-codominance-and-sex-linked-characteristics/ [8] Save My Exams. *The Inheritance of Sex*. https://www.savemyexams.com/igcse/biology/cie/23/revision-notes/17-inheritance/17-1-inheritance-genes-and-cell-division/17-1-2-the-inheritance-of-sex/